DISTRIBUTION

This snake is one of the least collected species in Australia. Glauert (1967) states that the species is "probably confined to the lower South-west. The specimen in the W.A. Museum came from Wagin; there is one in the Museum of Comparative Zoology at Harvard from Augusta; those in the National Museum, Melbourne, and the British Museum (Natural History) are merely labelled 'West Australia' and probably came from the vicinity of King George Sound." Dr. Storr informs me that since Mr. Glauert wrote his handbook six specimens have been added to their collection. They came from the following localities: Esperance, Bluff River (10 miles east of Cheyne Beach), Albany, Nornalup (5 miles NNW), Augusta (Mammoth cave) and Yelverton.

The species therefore has a fairly wide range and with the single exception of the specimen from Wagin the distribution appears to be coastal or sub-coastal. Considering the type of habitat in which the above two specimens were captured and the distribution of the other collections, it seems to me that the species may prefer sclerophyllous heath areas—areas with sandy soils which become largely saturated or even flooded during winter. The snakes could overwinter in ants nests on the elevated areas.

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APERIODIC STARTING RAINS IN TROPICAL WESTERN AUSTRALIA

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In general, the awakening of nature in a warm dry environment is determined by an increased supply of moisture. If this increase is adequate, the soil is moistened, seeds germinate, birds begin courting and nesting activities, animals that had burrowed to survive the unfavourable conditions become active again and emerge from the ground. The exact amount of rain needed to trigger off these various activities varies in each case. There may also be false starts, some of which have tragic results. It is undoubted, however, that occasionally the falls of rain are so great that every suitable form of life is activated again, and is enabled to continue activities successfully.

In the Kimberley region the normal time for such awakening of nature is the summer, but the first adequate rains may arrive any time between October and January. In the North Kimberley a monthly total of 25 mm (1 inch) or more comes some 10 per cent of the years in October, more than 70 per cent of the years in November and otherwise in December. In the East Kimberley the onset is slightly later, coming nearly 20 per cent of the years in October, nearly 40 per cent of the years in November, nearly 30 per cent of the years in December, occasionally in January. In the West Kimberley this monthly total has never been reached in October, some 10 per cent of the time in November, over 50 per cent of the time in December, over 30 per cent of the time in January. These are district average figures, and while correct for the whole area, may not apply to exceptional localities.

The last month to receive at least 25 mm (1 inch) in the North Kimberley is some 40 per cent of the time March, over 20 per cent of the time April, over 20 per cent of the time May, over 10 per cent of the time June, and nearly 10 per cent of the time July. August is the first month to be practically dry every year.

In the East Kimberley every month has been nearly dry at least once. February has been the last month to get at least 25 mm in over 30 per cent of the years, March in over 40 per cent, April in some 10 per cent, May also in some 10 per cent. Heavy rains have occasionally fallen in later months.

In the West Kimberley the tapering off is even more gradual. February has been the last month with at least 25 mm in some 20 per cent of the years, March in nearly 60 per cent; April received over 25 mm in more than 20 per cent of the years, and was followed by an occasionally wetter May. Very exceptionally even June or July could get heavy rains. The first month with a near certainty of drought is August, and September is drier still.

The Bureau of Meteorology has ranked the monthly rainfall amounts received each month, by the West Kimberley district, from 1913 to 1969. Every tenth monthly total is given below, in mm:

TABLE 1.—PER CENT RANKING OF MONTHLY RAINFALLS, WEST KIMBERLEY (mm).

Month	Driest	10th	20th	30th	40th	Mid-value	60th	70th	80th	90th	Wettest
April	0	0	0	2	6	8	14	20	34	70	238
May	0	0	0	0	1	3	19	35	57	81	113
June	0	0	0	0	2	4	11	18	27	52	103

From this it appears that on more than half the years May is drier than April or June. However, a rainy May is likely to be wetter, and may easily get more than twice the June rainfall, and once and a half the April rainfall. In nearly 40 per cent of the years, May may receive over 25 mm, quite a significant amount.

Proceeding further south, one finds that April rains diminish, and May rains increase. June rains remain lower than May rains as far south as the Fortescue district. In the Gascoyne districts they become significantly higher. Further south, the "Mediterranean" pattern begins to appear, with a dry summer followed by an increasingly wet autumn and a wetter early winter.

A tabulation of every tenth value of the ranked May rainfall for each district, in mm, is as follows:

TABLE 2.—PER CENT RANKING OF MAY RAINFALLS BY DISTRICT (mm).

District	Driest	10th	20th	30th	40th	Mid-value	60th	70th	80th	90th	Wettest
N. Kimberley	0	0	0	0	1	4	10	26	41	81	292
E. Kimberley	0	0	0	0	0	1	4	11	21	34	73
W. Kimberley	0	0	0	0	1	3	19	35	57	81	113
De Grey	0	0	1	2	5	11	20	33	48	83	128
Fortescue	0	2	4	6	12	21	35	47	71	92	115
W. Gascoyne	0	1	8	12	17	24	34	40	57	90	144
E. Gascoyne	0	0	3	5	7	14	16	24	38	53	128
North East	0	2	3	7	10	13	21	26	35	65	145
Murchison	0	2	8	12	18	20	25	35	45	60	141
N. Coastal	1	10	23	35	43	51	58	70	81	93	177
Central North	1	7	18	29	40	50	58	64	72	82	119
South East	1	4	10	14	21	24	25	30	37	55	137
Eucla	1	8	10	13	18	21	29	34	43	51	135
Centr. Coastal	22	39	53	87	112	129	132	148	170	215	244
Centr. South	7	17	29	40	49	60	65	77	84	92	120
S. Coastal	39	65	75	96	112	125	135	148	163	197	218

The table shows that May is likely to receive good rains in a significant proportion of the years even in the driest districts. The evenness of the rainfall amounts in the highest ranges is quite unexpected, and the wettest months of May on record received surprisingly similar amounts of rain in any district from the West Kimberley to the Gascoynes to the

Eucla. The obvious exceptions are the south-western coastal districts, where the higher latitude brings a greater frequency of rain-bearing fronts, and the topography of the scarp induces more frequent showers. When May is relatively dry, the effects of latitude and topography are also very definite.

A generalised map of the proportion of May rains to April and June rains based on district totals (Fig. 1) shows that May is wetter than both

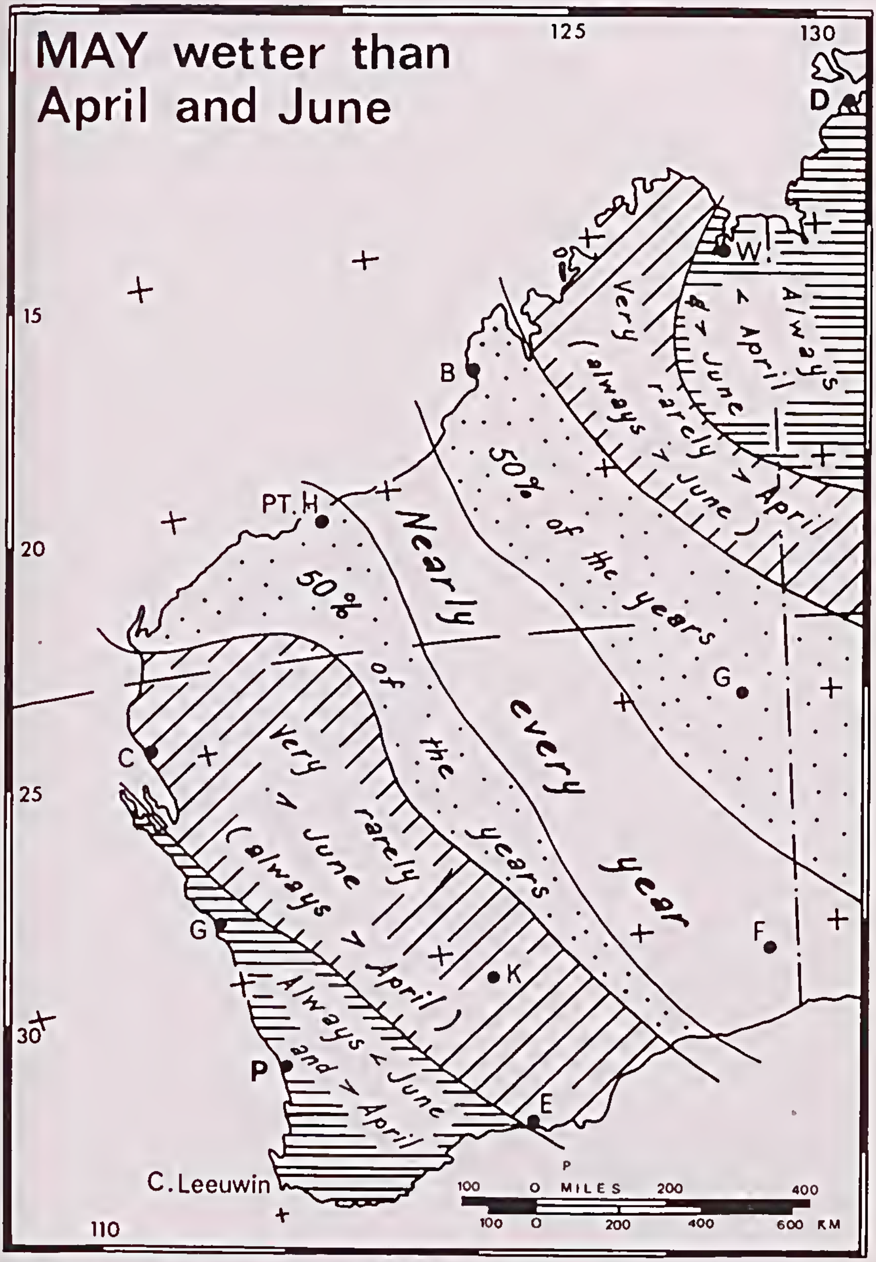

Fig. 1.—Approximate pattern of frequency of heavy May rains in relation to April and June rains (May wetter than April and/or June).

April and June in nearly every year along a belt which may reach from the Eighty Mile Beach to the Nullarbor Plain. Away from this belt the frequency of wetter Mays decreases in favour of April towards the north-east, and in favour of June towards the south-west.

The ecological implications of this pattern are significant. Even in the Kimberleys, where the normal wet season is the summer (with the variants mentioned above), there may be a wet spell in late autumn or early winter, sufficient to initiate a new bioactive cycle. The table below shows some of these wet spells at some representative stations, excluding tropical cyclones.

TABLE 3.—MAY RAINFALL (mm).

Station	1941	1942	1947	1950	1953	1954	1955	1958	1959	1962	1963	1964	1968
Kalumburu	—	100	—	—	—	—	84	20	109	20	4	103	92
Wyndham	9	59	—	—	—	—	77	—	24	—	—	—	98
Derby	72	42	—	27	10	—	61	—	41	2	129	85	99
Broome	77	13	—	176	10	2	117	—	35	20	50	120	95
Halls Creek	62	22	—	1	—	—	40	—	80	21	2	41	52
La Grange	73	—	—	203	—	—	100	5	46	8	95	56	119
Port Hedland	36	53	2	127	91	20	88	8	29	10	122	23	30
Whim Creek	12	28	1	101	33	32	99	—	10	12	51	16	17
Roebourne	27	225	14	126	61	60	123	1	7	13	81	20	9
Marble Bar	15	41	4	124	149	42	106	—	—	3	58	45	27
Onslow	65	253	107	98	105	41	78	7	20	12	96	67	15
Nullagine	20	52	3	38	157	71	112	1	—	15	36	60	12
Carnarvon	55	77	104	27	195	10	32	99	2	64	128	1	13
Hamelin Pool	19	25	127	45	100	25	48	64	10	58	97	—	12
Meekatharra	20	70	45	26	31	45	15	27	—	27	64	—	29
Murgoo	13	51	56	73	31	34	11	51	2	63	86	—	15
Yalgoo	45	100	50	71	48	50	21	49	2	89	86	—	16

The smaller monthly totals have been included in order to show the broad outline of the area affected in each case. For instance, in 1959 and 1968 wet Mays occurred mostly in the northern districts; in 1947 and 1953 they mostly concerned the North-West. In 1942, 1950, 1955 and 1963 distinct falls occurred in several areas, as happens when a similar weather situation recurs.

These heavy falls are unpredictable, and may or may not occur in consecutive years. A comparison of earlier and later data shows that in earlier years they affected the long-term average south of the tropic, while in 1931-60 their influence became greater north of the tropic (Fig. 2). At Broome, May totals of 50 mm (2 inches) or more occurred once between 1889 and 1900, three times in 1901-25, five times in 1926-50, and already five times in the shorter period 1951-69. At Marble Bar the frequency was none before 1901, six in 1901-25, two in 1926-50 (a tropical cyclone in 1949, and a non-cyclonic downpour in 1950), four in 1951-69.

At Carnarvon, the frequency of these heavy May falls was 2 in 1883-1900, rising to 8 in 1901-25, and 9 (including a tropical cyclone) in 1926-50. As at Marble Bar, there were 4 Mays with rains over 50 mm in 1951-69—but only in 1953 and 1963 were they the same at both localities. At Yalgoo, because of the distance from the coast, such heavy rains are less frequent: 1 in 1897-1900, 5 in 1901-25, 4 in 1926-50, 2 in 1951-69, a total of 12 in the 70 years in which Carnarvon had 22. Even if one included monthly totals between 25 and 50 mm, the relative difference between the two localities would change only slightly. There is also very little correlation between May and June rains: a very wet May may be followed by a very dry June (e.g. 1926, 1962) or vice-versa (e.g. 1925, 1927 1959) or both months could be very wet (1942, 1963) or very dry (1935, 1940, 1944). In general, however, at this latitude June is more likely to receive more rain than May.

These falls of rain are more than sufficient to alter the average for the month but infrequent enough and irregular enough to be unpredictable, and to have unpredictable effects. They may flood vast tracts of country, activate whole environments, be life-giving to some species and deadly through a false start to others. They are linked with marked inflexions of the jet stream and, further south, with active weather fronts at the surface. Their cloud systems, as shown by satellite photographs, are enormous and turbulent, suggesting great atmospheric instability; this last aspect appears to be confirmed by the early afternoon downpours. But the exact mechanism remains unknown.

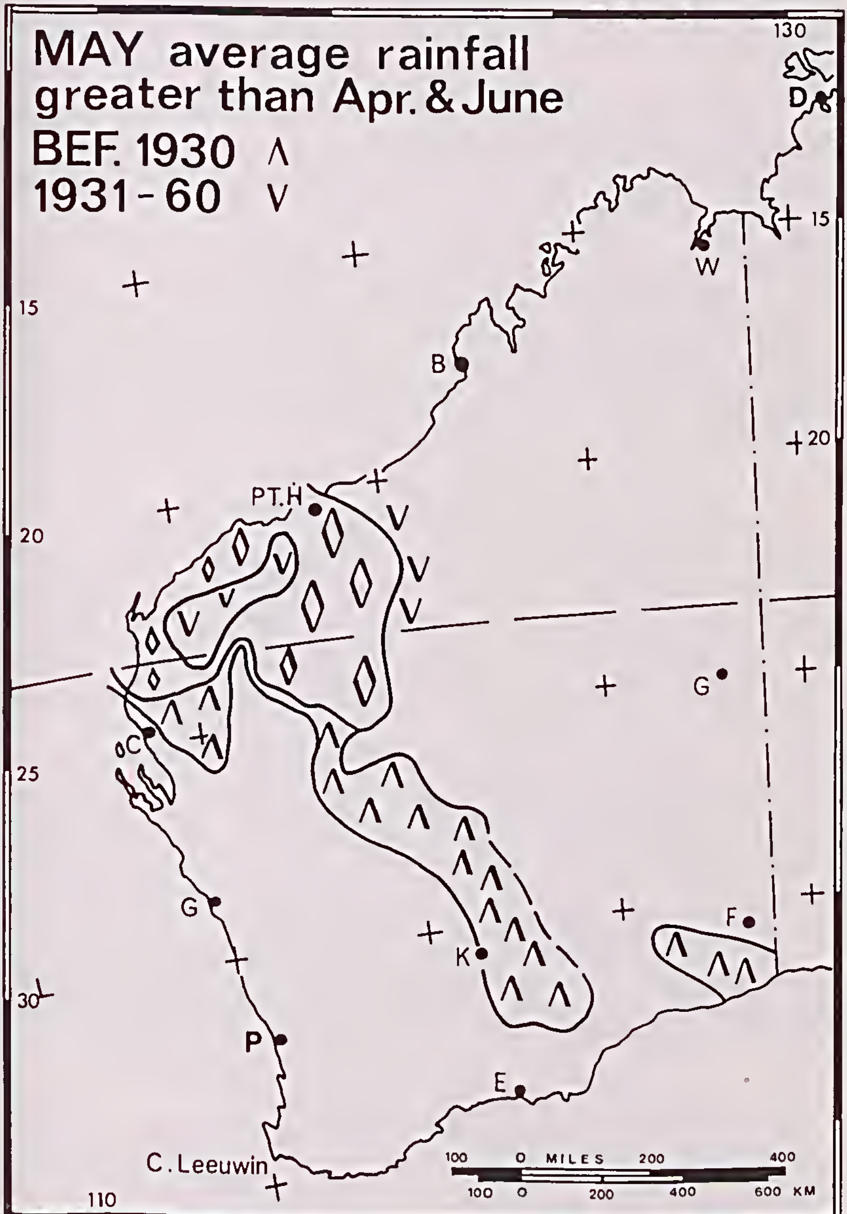

Fig. 2.—Long-term changes in the location of the belt of heavy May rains over the periods before and after 1930. Notice the main core in the North-West. Giles, a key station, has only been functioning in recent years and its results may only be referred to this period.